

FALSEWORK OVER AND/OR ADJACENT TO UNION PACIFIC RAILROAD COMPANY TRACKS

Railroad Guidelines

Until the Union Pacific Railroad Company (UPRR) issues new guidelines, falsework design for contracts involving UPRR facilities shall be in accordance with the Southern Pacific Lines (SPL) guidelines titled *GUIDELINES FOR DESIGN OF FALSEWORK FOR STRUCTURES OVER RAILROAD IN CONNECTION WITH HIGHWAY GRADE SEPARATION CONSTRUCTION*, with the exceptions noted herein. Refer to Attachment No. 1 for a copy of this guideline.

The contract special provisions will list the clearance requirements measured from the centerline of the railroad tracks. If clearances are not included in your contract documents, refer to UPRR Std. Dwg. 0035, "Barriers and Clearances to be Provided at Highway, Street, and Pedestrian Overpasses" for minimum construction clearance requirements. Refer to Attachment No. 2 for a copy of this drawing. This drawing shows the latest UPRR clearance requirements and will be incorporated into future contracts.

Where there is a conflict between the contract specifications and the guidelines issued by the railroad, the contract specifications shall prevail.

Railroad Requirements

It should be noted that the UPRR does not require the use of temporary collision posts. If collision posts are required per the contract special provisions, a contract change order may be prepared to eliminate them.

The UPRR has requested that drawings accompanying falsework plans be submitted on 11"x17" (279.4 mm x 431.8 mm) sized paper. Future special provisions will be revised to state this requirement. Until this request becomes a specification requirement, you may request that the contractor submit the three sets of falsework plans for railroad review on 11"x17" (279.4 mm x 431.8 mm) sized paper.

Some common requirements are often overlooked and have resulted in submittals being returned by the railroad. The falsework plans should note how the contractor will gain access to the site, particularly if they must cross the railroad tracks. Track protection details are shown in the UPRR's *GUIDELINES FOR PREPARATION OF A BRIDGE DEMOLITION AND REMOVAL PLAN FOR STRUCTURES OVER RAILROAD*. Refer to Bridge Construction Memo 124-3 for a copy of this guideline.

FALSEWORK MEMO 7 (09/99)

The falsework plans should note if there are any existing drainage ditches or access roads being affected by the Contractor's operations related to the falsework system. If there are no existing drainage facilities or access roads, the falsework drawings should note this fact. Keep in mind that personnel from the railroad who are unfamiliar with the site often review the falsework plans.

The above railroad requirements should be discussed at the pre-construction meeting with the Contractor. It should also be stated that approval of falsework plans over and/or adjacent to UPRR tracks will be contingent upon UPRR approving the plans.

Distribution of Falsework Plans

The Structure Representative will review the falsework plans, and if necessary, return them to the Contractor for correction. Refer to Section 2-1.06B, "Procedure when Railroad Company Approval is Required", of the Falsework Manual for further requirements.

After the Structure Representative reviews and is satisfied that the falsework plans meet the specification requirements, he/she shall send the following items to the Division of Structure Construction Headquarters (DSC HQ):

1. Letter of transmittal from the Structure Representative listing all information submitted and stating the falsework plans and calculations have been reviewed and that they are considered to be satisfactory.
2. Four copies of Contractor's falsework plans (a minimum of three sets of 11" x 17" drawings for the railroad is preferred)
3. Three copies of the Contractor's calculations, tabbed to show key elements affecting the falsework over and adjacent to the railroad company's tracks
4. Three copies of Structure Representative's calculations, tabbed to show key elements affecting the falsework over and adjacent to the railroad company's tracks
5. Three copies of manufacturer's data relative to manufactured devices

Note: One copy of the above is for the DSC HQ office use, and the other copies are forwarded to the railroad. In the event that railroad personnel at the job site need copies of the above information, they are to obtain them from their headquarters.

The Structure Representative should not stamp the falsework plans 'Approved' until DSC HQ has notified them that the railroad has reviewed and accepted the falsework plans.

In order to complete the falsework review within the contract time specified, the Structure Representative should expedite their review and forward the submittal to the DSC HQ (Attention: John Gillis) via overnight mail.

Railroad Review and Approval

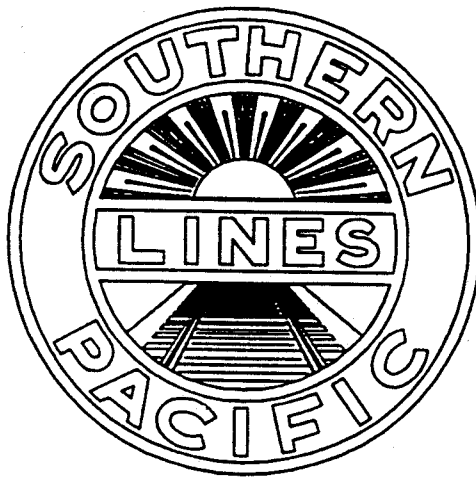
Incomplete or unsatisfactory data will be returned to the Structure Representative for correction. The DSC HQ will review this submittal package. Upon confirming that the plans and calculations are complete and satisfactory, the information will be forwarded to the railroad via overnight mail for their review and acceptance.

Please note that all correspondence with the railroad regarding the status of submittals under their review should be directed to John Gillis. At the railroad's request, in no case should you contact the railroad directly.

When the railroad completes their review and finds the plans to be acceptable, they will advise the DSC HQ who will in turn advise the Structure Representative that the railroad considers the falsework plans to be satisfactory. The Structure Representative will then stamp the plans 'Approved' and send a letter to the Contractor stating that the plans have been reviewed and approved. Assuming proper notification has been made to the UPRR that their horizontal and vertical clearances will be impaired and that a flagger is required, the Contractor may begin falsework construction. Note that the Contractor must not begin falsework construction of any components of the falsework system within the railroad right-of-way, including pads and piles, until such time as the approval letter has been issued to the Contractor.

Attachments

GUIDELINES FOR DESIGN OF
FALSEWORK
FOR STRUCTURES OVER RAILROAD
IN CONNECTION WITH
HIGHWAY GRADE SEPARATION
CONSTRUCTION



OFFICE OF
CHIEF ENGINEER
SAN FRANCISCO, CA

N.G.P.

SP13

SOUTHERN PACIFIC LINES

GUIDELINES FOR FALSEWORK DESIGN

I. GENERAL:

Falsework which is to be constructed over the Railroad operating tracks shall be designed in accordance with the following provisions.

The Contractor shall be responsible for designing and constructing safe and adequate falsework which provides the necessary rigidity, supports the loads imposed, and produces, in the finished structure, the lines and grades indicated on the plans.

Approval by the Railroad of the designs and working drawings will not relieve the submitting agency and/or Contractor of the ultimate responsibility and liability for the falsework.

II. FALSEWORK DESIGN AND DRAWINGS:

The Contractor shall submit to the Engineer working drawings and design calculations for the falsework proposed for use at bridges. For falsework over railroad tracks, drawings shall be signed by a registered Civil Engineer in the State where the proposed falsework is to be constructed. Three (3) sets of the drawings and one copy of design calculations shall be furnished to the Railroad for review and approval. A minimum 30 days should be allowed for the Railroad's review after all drawings and supporting material are received. No falsework construction will be allowed until the plans and calculations are reviewed and approved by the Office of Chief Engineer. Plans and calculations covering all falsework adjacent to Railroad's operating tracks shall be certified to be complete and satisfactory to the submitting public agency prior to being submitted to the Railroad.

The falsework drawings shall include a superstructure concrete placing sequence and construction joint locations. When a schedule of placing concrete is shown on the contract plans, no deviation will be permitted without the approval of design engineer.

When footing type foundations are to be used, the Contractor shall determine the bearing value of the soil and shall show the values assumed in the design of the falsework on the falsework drawings.

Anticipated total settlement of the falsework and forms

shall be shown on the falsework drawings.

Falsework footings shall be designed to carry the load imposed upon them without exceeding the estimated soil bearing values and anticipated settlement.

The support systems for form panels supporting concrete deck slabs and overhangs on girder bridges shall also be considered to be falsework and designed as such.

Temporary bracing shall be provided, as necessary, to withstand all imposed loads during erection, construction and removal of any falsework, to a point 14 feet from the centerline of any railroad track. The falsework drawings shall show provisions for such temporary bracing or methods to be used to conform to this requirement during each phase of erection and removal. Wind loads shall be included in the design of such bracing or methods.

III. DESIGN LOADS:

The design load for falsework shall consist of the sum of dead and live vertical loads, and the assumed horizontal load. The minimum total design load for any falsework shall be not less than 100 pounds per square foot for the combined live and dead load regardless of slab thickness.

Dead load shall include the weight of concrete, reinforcing steel, forms and falsework. The weight of concrete, reinforcing steel and forms shall be assumed to be not less than 160 pounds per cubic foot for normal concrete.

Live loads shall consist of the actual weight of any equipment to be supported by the falsework, applied as concentrated loads at the points of contact and a uniform load of not less than 20 pounds per square foot applied over the area supported, plus 75 pounds per linear foot applied at the outside edge of deck overhangs.

The assumed horizontal load to be resisted by the falsework bracing system shall be the sum of the actual horizontal loads due to equipment, construction sequence or other causes and an allowance for wind, but in no case shall the assumed horizontal load to be resisted in any direction be less than 2 percent of the total dead load. The falsework shall be designed so that it will have sufficient rigidity to resist the assumed horizontal load without considering the weight of the concrete.

The minimum horizontal load to be allowed for wind on each heavy-duty steel shore having a vertical load carrying capacity exceeding 30 kips per leg shall be the sum of the

products of the wind impact area, shape factor, and the applicable wind pressure value for each height zone. The wind impact area is the total projected area of all the elements in the tower face normal to the applied wind. The shape factor for heavy-duty shoring shall be taken as 2.2. Wind pressure values shall be determined from the following table:

Height Zone (Feet above ground)	WIND PRESSURE VALUE	
	Shores Adjacent to Traffic Openings	At Other Locations
0 to 30	20 psf	15 psf
30 to 50	25 psf	20 psf
50 to 100	30 psf	25 psf
Over 100	35 psf	30 psf

The minimum horizontal load to be allowed for wind for on all other types of falsework, including falsework supported on heavy-duty shoring, shall be the sum of the products of the wind impact area and the applicable wind pressure value for each height zone. The wind impact area is the gross projected area of the falsework and any unrestrained portion of the permanent structure, excluding the areas between falsework posts or towers where diagonal bracing is not used. Wind pressure values shall be determined from the following table:

Height Zone (Feet above ground)	WIND PRESSURE VALUE	
	Shores Adjacent to Traffic Openings	At Other Locations
0 to 30	2.0 Q psf	1.5 Q psf
30 to 50	2.5 Q psf	2.0 Q psf
50 to 100	3.0 Q psf	2.5 Q psf
Over 100	3.5 Q psf	3.0 Q psf

The value of Q in the above tabulation shall be determined as follows:

$$Q = 1 + 0.2W; \text{ but shall not be more than } 10$$

In the preceding formula, W is the width of the falsework

system in feet, measured in the direction of the wind force being considered.

The entire superstructure cross-section, except railing, shall be considered to be placed at one time. If the concrete is to be prestressed, the falsework shall be designed to support any increased or readjusted loads caused by the prestressing forces.

IV. DESIGN STRESSES, LOADINGS, AND DEFLECTIONS:

The maximum allowable design stresses and loadings listed are based on the use of undamaged, high-quality materials and such stresses and loadings shall be reduced by the Contractor if lesser quality materials are to be used.

The maximum allowable stresses, loadings and deflections used in the design of the falsework shall be as follows:

1. TIMBER:

Compression perpendicular to the grain.....450 psi

Compression parallel to the grain..... $480,000 \div (L/d)^2$ psi,
but not to exceed 1,600 psi.

Flexural stress.....1,800 psi
reduced to 1,500 psi for members with a nominal depth of 8 inches or less.

Horizontal shear.....140 psi

Axial tension.....1,200 psi

Deflection due to the weight of concrete only1/240
of the span irrespective of the fact that the deflection may be compensated for by camber strips.

In the foregoing formulas, L is the unsupported length, d is the least dimension of a square or rectangular column, or the width of a square of equivalent cross-sectional area for round columns.

The maximum modulus of elasticity (E) for timber shall be 1.6×10^6 psi.

Timber piles, maximum loading.....45 tons

Timber connections shall be designed in accordance with the stress and loads allowed in the National Design Specification of Wood Construction, as published by the National Forest Products Association except that (1)

reductions in allowable loads required therein for high moisture condition of the lumber and service conditions shall not apply, and (2) the design value of bolts in two member connections (single shear) when used for falsework bracing shall be 0.75 of the tabulated design value.

2. STEEL:

For identified grades of steel, design stresses, except stresses due to flexural compression, shall not exceed those specified in the Manual of Steel Construction as published by the AISC.

When the grade of steel cannot be positively identified, design stresses, except stresses due to flexural compression, shall not exceed either those specified in said AISC Manual for ASTM Designation: A-36 steel or the following:

Tension, axial and flexural.....22,000 psi

Compression, axial..... $16,000 - 0.38(L/r)^2$ psi
except L/r shall not exceed 120.

Shear on gross section of web14,500 psi

Web crippling for rolled shapes.....27,000 psi

For all grades of steel, design stresses and deflections shall not exceed the following:

Compression, flexural..... $(12,000,000) \div (Ld/bt)$ psi,
but not to exceed 22,000 psi for unidentified steel or steel conforming to ASTM Designation: A 36 nor $0.6F_y$ for other identified steel.

Deflection due to the weight of concrete only..... $1/240$
of span irrespective of the fact that the deflection may be compensated for by camber strips.

In the foregoing formulas, L is the unsupported length; d is the least dimension of rectangular columns, or the width of a square of equivalent cross-sectional area for round columns, or the depth of beams; b is the width and t is the thickness of the compression flange; and r is the radius of gyration of the member. All dimensions are expressed in inches. F_y is specified minimum yield stress, psi, for the grade of steel used.

The modulus of elasticity (E) used for steel shall be 30×10^6 psi.

3. MANUFACTURED ASSEMBLIES:

The maximum loadings and deflections used on jacks, brackets, columns, joists and other manufactured devices shall not exceed the manufacturer's recommendations except that the dead load deflection of such joists used at locations other than under deck slabs between girders shall not exceed $1/240$ of their spans. If requested by the Engineer, the Contractor shall furnish engineering data from the manufacturer verifying the manufacturer's recommendations or shall perform tests as necessary to demonstrate the adequacy of any such device proposed for use.

V. SPECIAL CONDITIONS:

In addition to the minimum requirements specified in Section II, falsework over or adjacent to Railroad tracks which are open to traffic shall be designed and constructed so that the falsework will be stable if subjected to impact by vehicles. Falsework posts which support members that cross over railroad shall be considered as adjacent to railroads. Other falsework posts shall be considered as adjacent to railroads only if they are located in the row of falsework posts within a distance which is less than the total height of the falsework and forms from the centerline of the track. The Contractor shall provide any additional features for the work needed to insure the falsework will be stable if subjected to impact by vehicles. The falsework design shall include but not limited to the following minimum provisions:

The vertical load used for design of falsework posts and towers, but not footings, which support the portion of the falsework over openings, shall be the greater of the following:

- (1) 150 percent of the design load calculated in accordance with the provisions for the design load previously specified but not including any increased or readjusted loads caused by the prestressing forces, or
- (2) the increased or readjusted loads caused by the prestressing forces.

Falsework posts adjacent to railroads shall consist of either steel with a minimum section modulus about each axis of 9.5 inches cubed or sound timbers with a minimum section modulus about each axis of 250 inches cubed.

Each falsework post adjacent to railroad shall be mechanically connected to its supporting footing at its base, or otherwise laterally restrained, so as to withstand

a force of not less than 2,000 pounds applied at the base of the post in any direction except toward the railroad track. Such posts also shall be mechanically connected to the falsework cap or stringer. Such mechanical connection shall be capable of resisting a load in any horizontal direction of not less than 1,000 pounds.

For falsework spans over Railroad, all stringers shall be mechanically connected to falsework cap or framing. Such mechanical connections shall be capable of resisting a load in any direction, including uplift on the stringer, of not less than 500 pounds.

When timber members are used to brace falsework bents which are located adjacent to Railroad, all connections for such timber bracing shall be bolted type using 5/8 inch diameter or larger bolt

Falsework bents in HEAVY TRAFFIC MAIN LINES with freight and passenger service shall have a minimum horizontal clearance of 14'-0" from centerline of track. Temporary collision posts set in 6 feet of concrete and extending not less than 16 feet above top of rail shall be installed on both sides of the bent and located 10 feet clear of the centerline of track with web parallel to centerline of track and approximately 100 feet in advance of falsework. Falsework to be sheathed solid on the side adjacent to track between 3 and 17 feet above top of rail elevation. Sheathing shall consist of plywood not less than 5/8 inch thick or lumber not less than one inch thick (nominal). Bracing on such bents shall be adequate so that the bent will resist the required assumed horizontal load or 5,000 pounds whichever is greater. Collision posts and sheathing shall not be required if horizontal clearances to falsework is 18 feet or greater.

Falsework bents in LIGHT TRAFFIC LINES, DRILL, AND YARD TRACKS with or without passenger service shall have a minimum horizontal clearance of 10'-0" from centerline of track. All other criteria shall be same as heavy traffic lines above except that collision posts and sheathing shall not be required if the horizontal clearance is 14 feet or greater.

A minimum vertical clearance of 21'-6" above top of higher rail shall be maintained at all times.

Any proposed temporary clearances less than those above must be submitted to the Railroad for review and approval prior to construction, and also must be authorized by the utility regulatory agency of the state if less than clearances legally prescribed.

VI. FALSEWORK CONSTRUCTION:

The falsework shall be constructed to substantially conform to the falsework drawings. The materials used in the falsework construction shall be of quality necessary to sustain the stress required by the falsework design. The workmanship used in falsework construction shall be of such quality that the falsework will support the loads imposed on it without excessive settlement or take-up beyond that shown on the falsework drawings.

Falsework shall be founded on solid footing safe against undermining, protected from softening, and capable of supporting the loads imposed on it. When requested by the Engineer, the Contractor shall demonstrate by suitable load tests that the soil bearing values assumed for the design of the falsework do not exceed the supporting capacity of the soil.

When falsework is to be supported on piles, the piles shall be driven to the bearing value equal to the total calculated pile loading as shown on the falsework drawings.

For falsework over or adjacent Railroad tracks, all details of the falsework system which contribute to the horizontal stability and resistance to impact, except for bolts in bracing, shall be installed at the time each element of the falsework is erected and shall remain in place until the falsework is removed.

Camber strips shall be used where directed by the Engineer to compensate for falsework deflection, vertical alignment and anticipated structure deflection.

Contractor shall provide tell-tales attached to the soffit forms and readable from the ground in enough systematically placed locations to determine the total settlement of the entire portion of the structure where concrete is being placed.

VII. REMOVING FALSEWORK:

Falsework supporting any span of a simple span bridge shall not be released before 10 days after the last concrete, excluding concrete above the bridge deck, has been placed in that span and in the adjacent portions of each adjoining span of a length equal to at least $1/2$ the length of the span where falsework is to be released.

Falsework for cast-in-place prestressed portions of structures shall not be released until after the prestressing steel has been tensioned.

Falsework supporting any span of a continuous or rigid frame bridge shall not be removed until all required prestressing has been completed in that span and in the adjacent portions of each adjoining span for a length equal to at least 1/2 the length of the span where falsework is to be released.

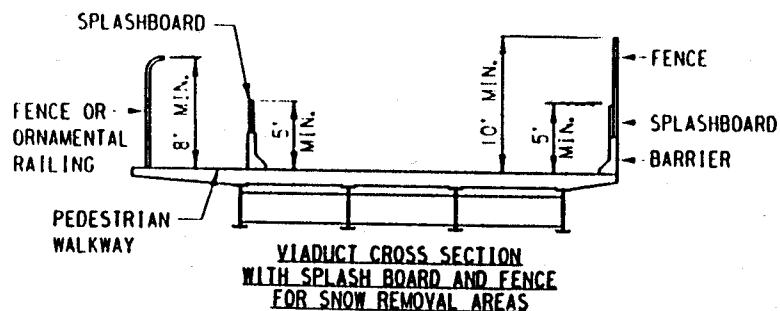
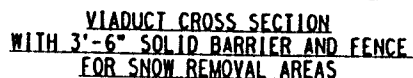
Falsework supporting overhangs, deck slabs between girders and girder stems which slope 45 degrees or more off vertical shall not be released before 7 days after the deck concrete has been placed.

In addition to the above requirements, no falsework for bridge spans shall be released until the supported concrete has attained a compressive strength of 2,600 pounds per square inch or 80 percent of the specified strength, whichever is higher.

When falsework piling are used to support falsework within the limits of the railroad right-of-way such piling within this area shall be removed to at least 2 feet below the finished grades.

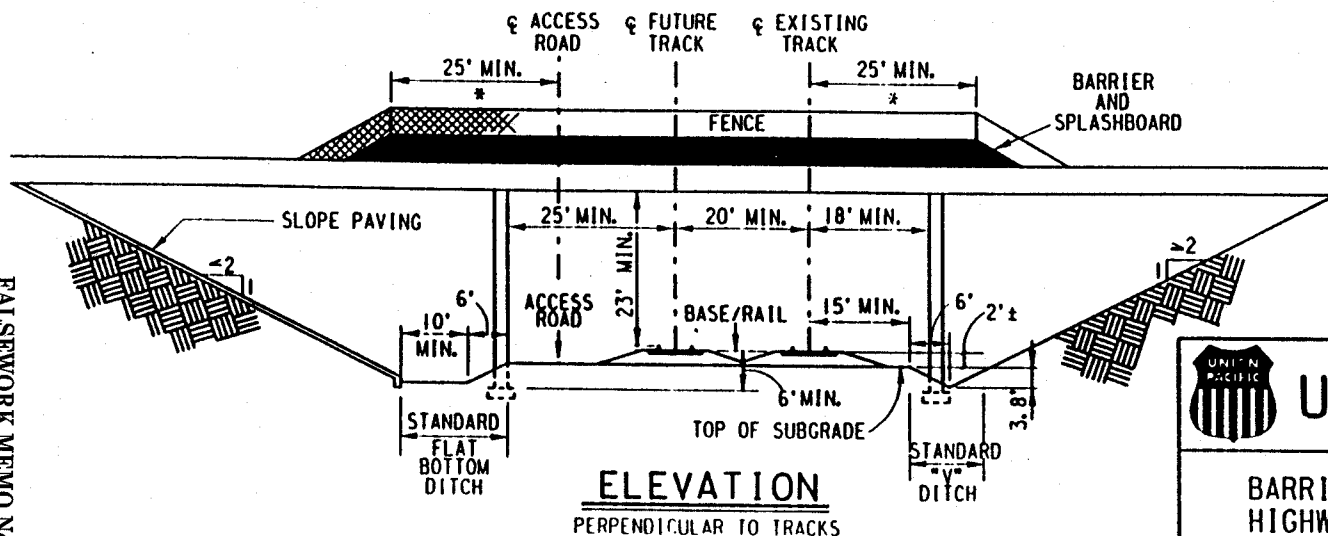
All debris and refuse resulting from the work shall be removed and the premises left in a neat and presentable condition.

SOUTHERN PACIFIC LINES
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Exceptions to these standards must be approved by UPRR's Chief Engineer Design.

Culverts may be installed on opposite side of column from track in lieu of standard Railroad ditches when approved by Chief Engineer Design. Maintenance of culverts is to be at applicant's expense.



* Fences, splashboards, or solid barriers if required shall extend 25ft. beyond centerline of outer most track or access roadway.



UNION PACIFIC RAILROAD

BARRIERS AND CLEARANCES TO BE PROVIDED AT HIGHWAY, STREET, AND PEDESTRIAN OVERPASSES

OFFICE OF CHIEF ENGINEER DESIGN

REVISED: MAR. 31, 1998

STD DWG 0038